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AUTHOR Petrun, Craig J.
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ABSTRACT

Interactions between metaphor comprehension and level of operational thought were examined to determine what advantages individuals at the formal operational level had in natural language tasks such as the understanding of figurative language. After 30 undergraduate students were classified as either late concrete, early formal, or late formal operational, they were presented with ten literal, ten similarity, and ten proportional metaphors. The subjects were asked to paraphrase the meaning of each sentence aloud as quickly as possible, and not to begin the paraphrase until they had a complete answer in mind. Latency from the time of sentence presentation to initiation of the paraphrase was recorded by a digital timer. A significant interaction was found between operational level and type of sentence. Planned comparisons revealed that paraphrase latencies for proportional metaphors were significantly shorter for late formal operational subjects than either late concrete or early formal operational subjects. Formal operational subjects paraphrased proportional metaphors as quickly as similarity metaphors. It was concluded that level of operational development was significantly related to metaphor comprehension in young adults. (Author/RL)

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Metaphor Comprehension and Cognitive Development in College Students

Craig J. Petrun

University of Kentucky

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Address Correspondence to: Craig J. Petrun, Psychology Department-Kastle Hall, University of Kentucky, Lexington, Kentucky, 40506.

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Metaphor Comprehension and Cognitive Development in College Students.

Craig J. Petrun
University of Kentucky

The study of language comprehension has primarily focused on the interpretation of the literal meanings of sentences (Chomsky, 1965; Katz & Fodor, 1963). Because of this, we have tended to overlook a system of communication (figurative language) which is prevalent in teaching, political rhetoric, problem solving, reading and everyday conversation. In recent years, psychologists have begun to examine the development of figurative language comprehension in children. Current research on metaphor comprehension in children has shown that the ability to process metaphors develops in a sequential order (Billow, 1975; Cometa & Eson, 1978; Winner, Rosenstiel, & Gardner, 1976). Several studies have suggested that a relationship exists between the ability to understand different types of metaphors and the level of Piagetian cognitive development attained in children and adolescents (Arlin, 1977; Billow, 1975; Elfman, 1979).

Billow (1975) performed a study investigating the relationship between operational level and metaphor comprehension in children of ages 5 to 14 years old. Billow compared the ability of the children to paraphrase either similarity or proportional metaphors. A proportional metaphor involves the comparison of two pairs of elements, while a similarity

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metaphor involves the comparison of two dissimilar objects with respect to a shared attribute. Billow suggested that proportional metaphor comprehension requires the same type of proportional reasoning involved in formal operational tasks, while similarity metaphors do not. For example, in the similarity metaphor "The girl's hair was spaghetti," hair is compared to spaghetti on the basis of shared attributes: both are long and thin. In the proportional metaphor "Hours are the leaves of life," (cited in Billow, 1975), however, three stated elements are complimented by an implied fourth element to form the following proportion Hours:life :: leaves:trees. Billow found that there was an overall significant relationship between operational development and metaphor comprehension; specifically, while most children were able to comprehend similarity metaphors, the attainment of formal operational thought was highly correlated with the ability to explain proportional metaphors.

The purpose of the present study was to examine the relationship between the time required for metaphor comprehension and level of formal operational thought in college students. This study attempted to determine whether advantages are afforded to individuals who have attained formal operational thought (as defined by performance on Piaget's balance task) in a natural language task, such as the understanding of figurative language. If cognitive abilities are independent of task content, as implied by Piaget, then differences in performance on the balance task should also be reflected in differences in linguistic abilities. It was hoped that this

study would also generate a new interest in formal operational research.

In the present study, subjects were asked to paraphrase metaphorical and nonmetaphorical sentences in order to induce full comprehension of the sentence. The amount of time needed to do this was measured by the latency of initiating the paraphrase. This measure has been used by MacKay (1966) and Harris (1976) in previous psycholinguistic research. Subjects' performance on this task was compared with their performance on Piaget's balance task. The balance task was chosen because of its ability to assess subjects understanding of the proportionality schema. It was hypothesized that young adult subjects who performed at the formal operational level would be able to paraphrase proportional metaphors more quickly than late concrete or early formal operational subjects.

METHOD

Subjects. The subjects were 30 undergraduate psychology students at the University of Kentucky who received course credit for their participation. All subjects were native speakers of the English language.

Materials. Twenty-five proportional metaphors were constructed for this study. While 20 of the metaphors were constructed by the author, 5 were adapted from Billow's (1975) study. In a pilot study, the metaphors were presented to students to ascertain the consistency of their interpretation. This study enabled the author to choose 10 proportional metaphors based on their

consensus of interpretation. In addition, 10 similarity metaphors and 10 literal sentences with the same average length as the proportional metaphors were constructed. Average length of the different sentence types was equated. Some of the similarity metaphors were modified from the list used in Billow's (1975) study.

Procedure. The students were first classified on the basis of their performance on Piaget's balance task as either late concrete (N=10), early formal (N=10), or late formal (N=10) operational. The subject's performance on the balance task was scored according to the original scoring criteria developed by Inhelder & Piaget (1958). Each subject was then presented with 10 literal (control) sentences, 10 similarity metaphors, and 10 proportionsl metaphors in a random order. They were asked to paraphrase the meaning of each sentence aloud as quickly as possible, and not to begin the paraphrase until they had a complete answer in mind. Latency from the time of sentence presentation to initiation of the paraphrase was recorded by a digital timer. Each subject's paraphrase was recorded and later checked for its accuracy. The reaction time for any paraphrases which were totally misinterpreted were eliminated from the analysis. The error rate for the similarity metaphors was 2% while for the proportional metaphors it was 7%. Finally, verbal ability was assessed by means of the Shipley-Institute of of Living Scale which consisted of a 40 word multiple choice vocabulary test and a 20 item abstraction test.

RESULTS.

A 3 X 3 repeated measures mixed analysis of covariance, with intelligence as the covariate, was calculated on the mean latencies (see figure 1 and table 1). This analysis showed the predicted main effect for sentence type, $F(2,54)=63.65$, $p<.008$: proportional metaphors took longer to paraphrase than either similarity metaphors or literal sentences. A main effect occurred for operational level, $F(2,26)=3.77$, $p<.03$: late formal operational subjects were faster in generating paraphrases than early formal or late concrete subjects. Furthermore, a significant interaction was found between operational level and type of sentence, $F(4,54)=3.87$, $p<.008$. Planned comparisons revealed that paraphrase latencies for proportional metaphors were significantly shorter for late formal operational subjects than for either late concrete or early formal subjects. Late formal subjects showed no significant differences among the three types of sentences.

DISCUSSION.

These results indicate that the level of operational development achieved during adolescence has a significant effect on the comprehension of figurative language. The late concrete and early formal subjects took significantly longer to paraphrase proportional metaphors. Formal operational subjects paraphrased proportional metaphors as quickly as similarity metaphors. These findings suggest that the proportionality schema which is believed to be acquired during formal operational development is reflected in the processing

of proportional metaphors. The data provide empirical support for the suggestions of Billow (1975), Cometa & Eson (1978), and Elfman (1979) that individual differences in the level of operational thought can affect figurative language comprehension. While these earlier studies were performed on children, the present study generalized this relationship to young adult subjects. It appears that young adults show advantages in a natural language task which are related to their degree of attainment of Piaget's formal operational stage of cognitive development.

The present results could also be seen as supporting Miller's (1979) suggestion that proportional metaphors are based on covert analogies. Miller (1979) also suggested that in attempting to comprehend a proportional metaphor the subject must construct the implied analogical comparison in order to arrive at an understanding of the metaphor. The need to use analogical or proportional reasoning to understand the proportional metaphors might then account for the advantage of late formal subjects in the metaphor comprehension task. For example, "Informers are the uranium of criminal justice" (cited in Ortony,1979), cannot be understood only in terms of the similarity between "informers", "uranium", and "criminal justice". Instead the following covert analogy must first be constructed; informers:criminal justice :: uranium:nuclear reactors. The relationship between each pair of terms must be understood and then simultaneously coordinated in order to determine their joint relationship. This is similar to what a subject must do in order to achieve equilibrium in

Piaget's balance task. First, the subject needs to understand the relationship between weight and distance on each side, and then simultaneously coordinate weight and distance on both sides of the balance to obtain equilibrium.

Gallagher (1978) in a chapter entitled "The future of formal thought and research: The study of analogy and metaphor" has also suggested that the importance recently granted by Piaget to the notion of correspondences might be a crucial concept linking operational thought and metaphor comprehension. Gallagher reasoned that if a subject is aware of the correspondence between what is lost on one side of the balance and what is gained on the other side, this will aid in understanding the transformation which occurs when one tries to make unequal weights balance. Piaget (1977a) has emphasized that "in the case of correspondences, development means finding the closest similarities or the closest resemblances between any two things in spite of their differences" (pg. 10). In the case of proportional metaphors, then, not only must the subject be able to set up the proportion, but he must be capable of searching for the commonalities or correspondences between the relationships of both sides of the proportion.

Finally, it is hoped that results such as these will stimulate an interest in formal operational research and its relationship to areas of cognition other than the development of scientific and mathematical reasoning. Recently, Palmquist (1979) has found that formal operational thought can affect the ability of an individual to ignore initial information about another individual in an impression formation task.

Keating & Clark (1980) have also found that formal operational thought has an effect on interpersonal reasoning and problem solving. In conclusion, the present data show that reaching the stage of formal operations affects not only scientific and mathematical reasoning in adolescents, but continues to affect an adult's reasoning abilities in other areas of cognition.

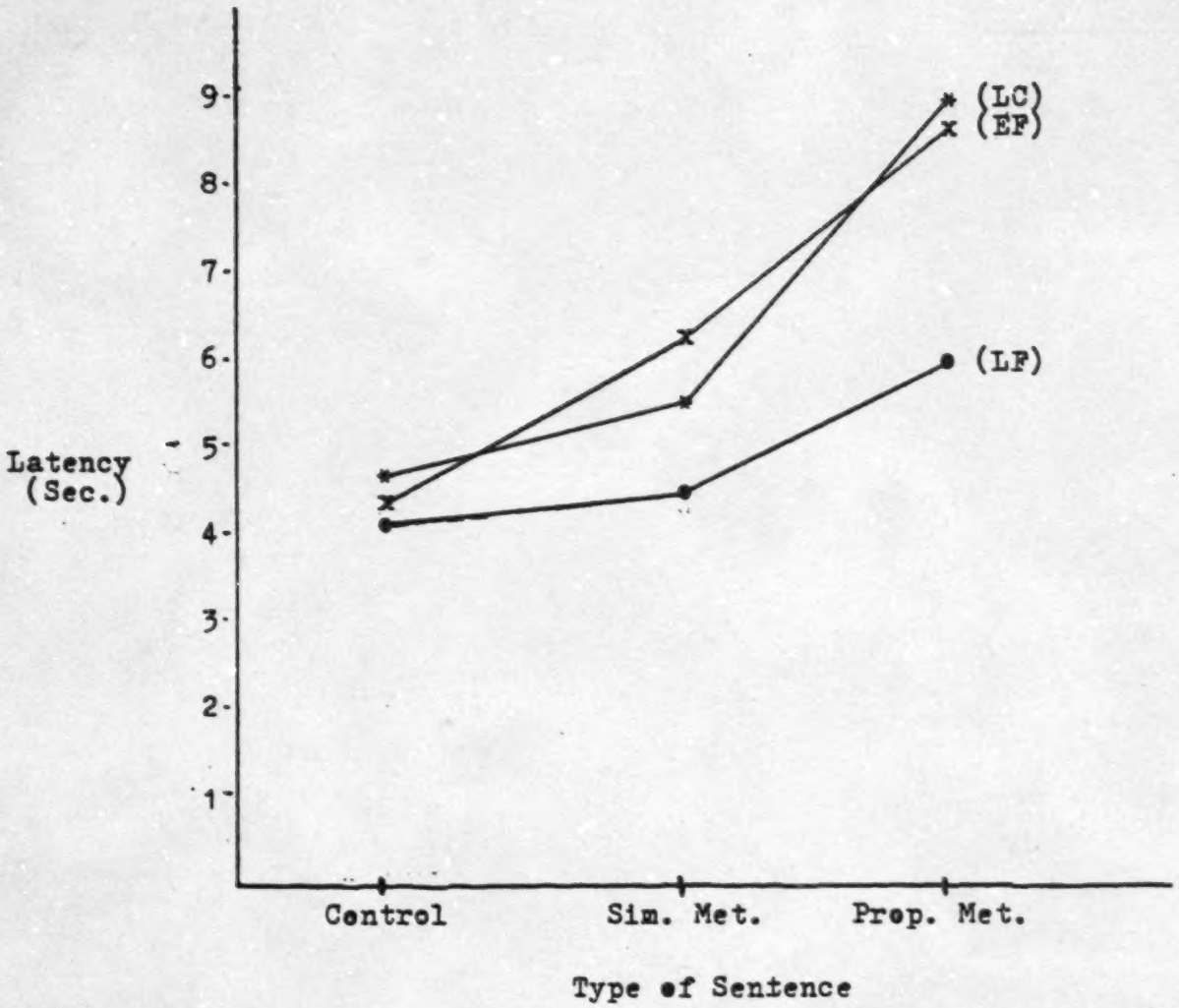

Figure I. Mean paraphrase latencies for late concrete (LC), early formal (EF), and late formal (LF) operational subjects.

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F
Operational level	2	54.4934	27.2469	3.77*
Covariate Intelligence	1	1.8739	1.8739	.26
Error	26	187.8628	7.2254	
Type of Sentence	2	197.5790	98.7895	63.65**
Sentence X Operational level	4	24.0395	6.0098	3.87**
Error	54	1.5520		

*p<.05
**p<.01

Table 1

Analysis of Covariance

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